

SCIENCE

FRIDAY, AUGUST 3, 1888.

A RECENT NUMBER of the Journal of the Society of Arts contains information of the projected railways in Asia Minor. A new railway is projected from Constantinople to Bagdad, to start from Ismid, the present terminus of a short line of railroad connecting that town with Scutari, the Asiatic suburb of Constantinople. Its length is about 1,400 miles, and the estimated cost is \$75,500,000. Throughout its length it will traverse a country well populated, abounding in mineral resources, and producing great quantities of grain. British consul Jewett, of Sivas, says that the great advantages to the country, commercially and as a civilizing influence, of such a road are too obvious to need mention. It is sufficient to say that it would create a new Asia Minor, open to the trade of the world a vast territory now closed, totally change the character of the country and the people, and practically advance Turkey in Asia from the sixteenth to the nineteenth century; moreover, the commercial world at large has a special interest in this project, as it will, if carried out, shorten the distance between Europe and India by nine or ten days, and give a route to the East independent of the Suez Canal. Should the railroad be built, it is said that Bagdad, as the *entrepôt* for the trade between the East and the West, is sure to attain a commercial importance hardly second to any city in the East. With the advent of the railroad, with the new towns and cities that will spring up, the new resources and industries developed, and especially with the new ideas and wants which civilization creates, there will be a new market, and a constantly increasing demand for almost everything which Europe and America manufacture.

WITH THE REAPPEARANCE this spring of our native birds in great numbers we expected to hear from some of our ornithologists as to a reasonable explanation. The reappearance was first noted in the New York papers, and was promptly credited to the liberal destruction of the pugnacious English sparrow, unable to withstand the storm-beating received in the great March blizzard. But counter to this explanation comes information from Illinois that the attention of all is attracted to the remarkably large number of birds that are to be seen. The groves, the woods, and the meadows in the country, and the many trees in the city, are peopled with these feathered visitors. The oldest inhabitant does not remember to have seen so many and such a variety of birds. And yet the great blizzard did not visit Illinois. The July *Auk*, the quarterly organ of the ornithologists, contains no hint as to the cause of this sudden return of the old birds, which we had been led to believe were so vastly reduced in numbers that only after a long respite from the attacks of the sparrows and the country's shot-guns could they possibly be restored to us in their former numbers. The birds are here, as numerous as ever, and have returned *en masse*.

THOMAS HUMPHREY WARD has published a 'Letter to the American People' on international copyright in works of art. The special occasion of this letter was the placing in his hands by a friend of a parcel of 'process' engravings and a number of trade catalogues issued by American publishing houses. These process engravings, and the grievance to which they have given rise, are an entirely new fact in the world of art. They are the result of the most modern improvements in the art of reproducing pictures. They bear many

names. They are called 'artotypes,' 'heliotypes,' 'albertypes,' but they are all varieties of the same method, — the method of applying photography to the purposes of engraving. They are, in fact, reproductions in photo-engraving of the best, the costliest, and the most popular modern English and French engravings and etchings. They are of imposing size, the artotypes measuring, when mounted, thirty inches by forty, and thus approximating to the dimensions of the engravings which they copy. They are showy, effective, and, to use the language of the workshop, 'well got up.' They are in no sense botched or bungled. They are quite a different thing from the German lithographs of our childhood, those *naïve* attempts in art by which the last generation of continental contrabandistas used to impose upon an unsophisticated world. These things are as like the works they counterfeit as the sun and the printing-press can make them. During the past ten or fifteen years, that is to say, since the recent great development of 'processes' has enabled American publishers to destroy the American demand for the first-hand works of European artists, their remuneration has fallen to a great extent. Fifteen years ago it was quite a common thing for an artist like the late Mr. Cousins to be paid a thousand pounds for a mezzotint plate, for the publisher who commissioned him knew that there were a sufficient number of buyers in Europe and America, taken together, to make such an outlay remunerative. It is not asserted that there are no longer men who can command a similar price, but they are so few that their existence hardly makes a difference in the question. In the case of one or two Englishmen, and one or two French or Dutch etchers, it is still possible for the publishers to give these heavy commissions. Fashion still points that way, and while the fashion lasts these men can be employed; but in the case of the great majority, even of distinguished engravers, the demand for their work is lamentably less than it was, not from any failure of appreciation on the part of the public, not from any failure of power on the part of the engravers, but simply because the returns are less than they used to be, and less almost exclusively on the American side.

IT IS THE CURRENT BELIEF that there has been nothing like the present Cincinnati Exposition since the great one at Philadelphia in 1876. People who were at New Orleans in 1885 say that this is enormously superior in all the arts, especially upon the mechanical and industrial side. The Exposition covers fifteen acres in the very heart of the city, and in every part of this large area one meets evidences of taste, skill, ingenuity, and perseverance in adapting means to ends, which form a series of apparently never-ending surprises as one passes from one exhibit to another. The government exhibits are all good and all characteristic. The Smithsonian Institution and the Geological Survey exhibits attract crowds. In the latter Prof. F. W. Clark has some transparent photographic views, represented in colors by some new and as yet undisclosed process. The effect is wonderfully natural and beautiful, and if it is found to be durable it will prove a great discovery. The very fine models of the new classes of naval vessels now building attract crowds daily, as do the various forms of weapons for wholesale slaughter in case we ever have another war. In close juxtaposition are the ingenious devices for saving life in cases of shipwreck, of the Life Saving Service. The Fish Commission exhibit is not as yet complete. In such elaborate displays, requiring much preparatory work, more time should have been allowed for preparation. The Post Office Department and the Army exhibits are also incomplete, but a few days will find every thing in order.

IN A RECENT NUMBER of *The Forum*, Mr. Lester F. Ward has an article on 'What shall the Public Schools Teach?' In this article Mr. Ward maintains that in refining upon the blessings of education we forget altogether what knowledge is for. His definition of civilization being that it consists in 'the utilization of the materials and forces of nature,' he holds that so far as the improvement of man's estate is concerned we know only in order to do, that knowledge unapplied is sterile, and is only fruitful when it makes two blades of grass grow where only one grew before, when it converts 'raw material' into useful objects, or when it directs into some useful channel the forces of nature which were previously running to waste or doing injury to man. Mr. Ward believes that nowadays all inventions are in the nature of 'improvements' upon pre-existing inventions, and are chiefly made by the mechanics or artisans of the higher grades, who are constantly using the original devices, and who, through an intimate acquaintance with these, eventually perceive how they may be improved; that as artisans become more intelligent this class of inventions will increase, and that nothing but the stolid ignorance of the working-classes in the past has prevented this from having always been the chief mode of advancing the useful arts; and the hope is expressed that in the near future the artisan as well as the engineer may not only receive a good education in the hitherto accepted sense of the term, but may also have such a training of the eye and the hand as will enable him to perceive and to effect all possible reforms in his chosen field of labor. Everywhere we see the lack of thought directed to the improvement of our material surroundings. If this is because the importance of improving those surroundings forms no part of the education which is given to the youth of the country, there is reason to believe that any system of education which will tend to develop the human powers of dealing with materials and forces will tend to raise the plane of civilization as defined. Mr. Ward even looks forward to the day when the need for the use of the human animal for the lowest forms of unthinking labor will be done away with, which would simply mean that there would be less opportunity for life among those of low intelligence, and that the 'average man' would be on a higher plane than at present.

This tendency to educate youth so that man may be the better able to deal with his material surroundings is doubtless wise, but brings forth a remonstrance occasionally from those versed in the old ways, who hasten to point out the other sides to a man's nature which come in contact with other conditions which he should be equally ready to contend with, or perhaps better to appreciate. The recently published life of the most illustrious and most amiable man of science of this scientific age has suggested to many readers doubts of the all-sufficiency of science to build up, not theories, but men. Mr. Darwin's admirably candid avowal of the gradual extinction in his mind of the æsthetic and religious elements has proved startling to a generation which, even when it is ready to abandon religion, would be direfully distressed to lose the pleasures afforded by art and nature, poetry and music. Instead of lifting the scientific vocation to the skies (as was probably anticipated), this epoch-making biography seems to Miss Frances Power Cobbe, writing of 'The Scientific Spirit of the Age,' in the *Contemporary Review*, to have gone far "to throw a sort of dam across the stream, and to have arrested not a few science-worshippers with the query," as Darwin wrote: "What shall it profit a man if he find the origin of species and know exactly how earth-worms and sun-dews conduct themselves, if all the while he grow blind to the loveliness of nature, deaf to music, insensible to poetry, and as unable to lift his soul to the divine and eternal as were the primeval apes from whom he has descended? Is this all that science can do for her devotee? Must he be shorn of the glory of humanity when he is ordained her priest? Does he find his loftiest faculties atrophied when he has become a 'machine for grinding general laws out of large collections of facts'?"

THE COAST AND GEODETIC SURVEY EXHIBIT AT CINCINNATI.

THE exhibit of the United States Coast and Geodetic Survey at the Cincinnati Exposition shows the principal instruments used in the geodetic, astronomical, topographical, hydrographic, and magnetic work of the Survey, with illustrations of the results of their use, as shown by a series of the annual reports, a number of the principal charts published, a collection of the more important scientific papers or works printed by the Survey, a model of an observing tripod as used in geodetic work, and models showing the basins of the Gulf of Mexico and of the western Atlantic, or 'Bay of North America,' constructed from the data furnished by the elaborate hydrographic surveys of those waters. The collection further includes an exhibit from the United States Bureau of Weights and Measures, which is under the care and direction of the Superintendent of the Coast and Geodetic Survey.

The Exposition occurs at a period of the year when many of the best instruments of the Survey, containing the latest improvements in their several departments of use, are in the hands of field parties and cannot be exhibited. To aid those interested in the exhibit, a pamphlet has been issued by the Survey explaining the instruments shown and their uses.

The great end and chief object of the Survey is, and has been, for a period of half a century, to furnish good and reliable charts of the coasts of the United States, and of its harbors and navigable rivers. These require in their construction a combination of skilful labor, differing greatly in means, appliances, and methods.

First in order is the reconnaissance and triangulation. Next comes the topographical survey of all that portion of the earth's surface which lies above the water. It includes all accidents of ground, all natural or artificial developments of surface, and every thing useful for purposes of commerce or defence.

Third in the chronological order of conducting a survey, but equal in its usefulness, is the development upon the chart of all that portion of the earth's surface which lies beneath the water. This important work is carried on by officers and enlisted men of the navy of the United States. There are 67 officers and 280 petty officers and seamen now engaged upon this duty. The instruments used in the work are only partly shown.

Although one of the minor branches of the operations of the Survey, the study and the application of the results of terrestrial magnetism from a practical point of view are of great importance, not only to the surveyor, but also to the mariner, to whom they are indeed indispensable.

This will be readily understood by simply referring to the extended use surveyors have made of the magnetic needle for the demarcation of land and the consequent frequent necessity of re-tracing old lines so laid out and recorded.

With reference to the use of the compass at sea, the charts of the Survey require the impress of the compass, they record the variation of the needle, and state the annual change so as to render the sailing directions applicable for other years than that of the issue of the chart. With reference to the adjustment of the compass on board ship, and the construction of deviation tables to answer for different directions, inclinations, and positions of the ship, a knowledge of the magnetic dip and the intensity is demanded. The labors of the Survey and their results may best be shown by a short historical review.

In the early years of the Survey under its first superintendent, the magnetic declination (the scientific term equivalent to the mariner's 'variation') was supplied to the charts as found by the ordinary nautical instrumental means then in vogue. In the Transactions of the American Philosophical Society (Philadelphia, 1825), he proposed to measure relative magnetic intensity by means of oscillations of a needle. The magnetic work of the Survey, however, may be said to have commenced in its three-fold aspects, the declination, the dip, and the intensity, with his successor in office in 1843. Professor Bache had previously made a magnetic survey of Pennsylvania, which, although a scanty beginning, was not followed until in quite recent years by the magnetic survey of Missouri. He imported new instruments suitable for more refined measures of the declination than could be secured by the older in-

struments, and at the same time capable of exact determinations of the intensity in absolute measure; he also procured dip circles, and availing himself of the additional temporary aid of Dr. Locke of Cincinnati and of Professor Renwick of Columbia College, the observational work was fairly started, and has since been prosecuted uninterruptedly by various assistants of the Survey. In consequence of the dual or polar character of the magnetic force, it resisted for a long time all attempts of measure expressible in the usual units, but in 1833 Gauss showed how this could be done, and after the invention, in 1836, of the portable magnetometer his method for the absolute measure of magnetic intensity came into general use.

Those who are acquainted with magnetic observations, which also include certain astronomical operations, know the delicacy and refinement of its operations when great accuracy is demanded, and it should also be remembered that in those early days of the development of practical methods there were none of those facilities we now possess in the number of trained observers, in the home manufacture of instruments, and in the many treatises for instruction now at hand. Apace with the field work the office work of computation and discussion was prosecuted, and the results were published from time to time in the annual reports.

At first the observations were confined to the vicinity of the sea-coast, but it was soon found that the charts could not satisfactorily be supplied with the values for the variation of the compass unless the observations were extended sufficiently inland to give proper direction to the magnetic lines, or isogonics as they are called, which curves determine the angular difference between the astronomical and magnetic meridian for a certain epoch. Meanwhile, surveyors from all parts of the country applied for information, not only for the present value of the declination, but what was far more difficult to answer, for the value at some earlier period. To satisfy this inquiry, and to provide for a better knowledge of the annual change of the declination needed for the charts, a more systematic general collection of all magnetic observations taken within the limits of the United States from the earliest to the present time was undertaken, and has been kept up since 1878, at which time the field of activity of the Survey was enlarged by the change of Coast into Coast and Geodetic Survey. This collection arranged by States and Territories now comprises several thousand observations of declination, dip, and relative and total intensities, and together with the direct survey work, which in July last comprised 731 stations (many of them occupied several times at definite intervals), constitutes the material from which most of the deductions were derived, and which mark the advancement of our knowledge in this department of research contributed by the Survey.

The first permanent magnetic observatories in North America were established at Toronto by the British Government about 1840 (which observatory is still in operation under the auspices of the Canadian Government), and about the same time at Philadelphia, 1840-45, at Girard College. The latter was directed by Professor Bache, who, after taking charge of the Coast Survey, took advantage of the newly invented application of photography to automatic registration, procured one of Brooke's magnetographs, and caused it to be set up and to record continuously the variations of the declination and of the horizontal and vertical intensities at Key West, Fla., between 1860 and 1866. After the lapse of half a sun spot cycle, which is the minimum duration for which it is profitable to keep up continuous observation at any one place, the instruments were transported to Madison, Wis., where between 1876 and 1880 a second series of observations was procured. When the support and co-operation of the Survey was asked for the two international expeditions fitted out by the United States for polar research, the needed magnetic instruments, both absolute and differential, so far as the Survey could supply them, were furnished and the observers were trained during the short time permitting.

The magnetic records of the second year (1882-83) at Point Barrow, Alaska, by the party in charge of Lieutenant Ray, were made by the Brooke magnetometers, which had in the mean time been altered for direct or eye-observations.

A superior self-recording magnetic apparatus, known as the Adie magnetograph, after the Kew pattern, and likewise working by means of photography, arrived here during the late war, but for

want of funds was not set up until 1882. This superior instrument was located at Los Angeles, Cal., and continues to give excellent results. It is intended to terminate this series towards the beginning of the next year, and then remount the instrument, either in Washington Territory near Puget Sound, or in southern Texas, in order to cover as much as possible of the space for which, heretofore, our knowledge of the laws of terrestrial magnetism was most incomplete.

The first isogonic chart published by the Survey, entitled 'Lines of Equal Magnetic Declination,' will be found in the annual report for 1855, the last one in three sheets appeared in the annual report for 1882: a comparison between these charts will show in the most conspicuous manner the progress made in our knowledge in this direction during the interval. The index to scientific papers in the annual report for 1881 under the heading of 'Terrestrial Magnetism,' enumerates no less than sixty-six titles up to the close of 1880; this will give some idea of the activity of the Survey in this department. Several important investigations have appeared in the later annual reports; in the report for 1882 we have an appendix discussing the distribution of the magnetic declination in the United States for the year 1885; the results are based on observations at more than 2,300 stations. In the report for 1885 we have an investigation of the magnetic dip and intensity, with their secular variations and their geographical distribution in the United States. This appendix, 145 quarto pages, involved much labor for its preparation: it is accompanied by three finely executed charts, besides the illustrations in the text, and discusses no less than 2,000 dip observations and more than 1,500 observations for intensity. The results for secular change of dip and intensity are new. In the report for 1886 (not yet issued) we have in type the sixth edition of an investigation much sought after, namely, 'The Secular Variation of the Magnetic Declination in the United States and at some Foreign Stations.' From a small beginning in 1859 this paper has grown to be a complete depository of magnetic results available for the study of the secular change within our territory, and the author discusses most thoroughly the laws governing this mysterious movement, the cause of which is as yet entirely unknown, though in its nature it must be cosmical, since we cannot think of any adequate cause within the earth to produce, so far as we can judge, with the utmost regularity, the observed angular motion of the needle during centuries.

The deductions rest on 1,071 observations made at ninety-four stations. The earliest observations on our western coast date from the sixteenth century (Sir Francis Drake), the earliest records on the eastern coast dating from the beginning of the next century (Hudson and Champlain). In this branch of research the Survey profited by the use of the valuable collection of declinations and dips, the earliest on record, made by Prof. E. Loomis (now of Yale College), who published them in *Silliman's Journal* in 1838 and 1840, and without which our results would not possess the degree of reliability they now have. In this sixth edition, which spreads over 116 quarto pages, we have minute references to observations, together with their critical examination. The resulting secular change, illustrated by several diagrams, is expressed analytically and is also given in tabular form. The laws which so far appeared to govern this motion are stated, and embrace the whole of the area of the United States (inclusive of Alaska), and are given sufficient expansion to facilitate their connection with similar relations referring to Europe, South America, and eastern Asia.

The magnetic records brought home by the polar expeditions in command of Lieutenants Ray and Greely were placed in care of the Coast and Geodetic Survey: this material was subjected to computation and discussion, and arranged for the press. The Point Barrow work (1881-83) forms part VI. of the official publication of Lieutenant Ray's expedition (published in 1885), and the work done at Fort Conger (1881-83) under Lieutenant Greely will form Appendix No. 139 of Vol. II. of the official publication now passing through the press.

The reduction, analysis, and discussion of the automatically registered material at the magnetic observatories still await sufficient computing force to bring out the many laws and complex relations due to the ceaseless changes of the magnetic force.

The annual expenditure on account of terrestrial magnetism is

small, being only about one two-hundredth part of the whole appropriation for the Survey.

Another of the subordinate branches of the Coast Survey work is the determination of the earth's density. The pendulum, being an instrument which will swing faster or slower according as the force of gravity is stronger or weaker, can be employed to measure this force. All forms of pendulums will determine variations of gravity, but different shapes are given it, depending upon the particular object in view. That approaching nearest the ideal mathematical pendulum would be a heavy ball suspended by a fine string. This form was used by Borda, and a modification of it by Bessel consisted of swinging the ball with strings of different lengths. Kater employed a form known as the invariable one,—meaning by the term 'invariable' that none of the parts of the pendulum are interchangeable, and that the instrument remains identical for experiments made at different stations. Kater's pattern is generally preferred when the object is simply a determination of the differences of the force of gravity for different places. The reversible pendulum is one having two points of suspension, which are so placed that the times of oscillation are equal, or nearly so, whether the instrument is hung in the direct or reversed position. This form is used when the object is the determination of the actual force of gravity, or in other words, how far a body will actually fall towards the earth in a given time. As the distance between the two points of suspension is equal to the length of a simple pendulum which would oscillate in the same time, the determination of the force of gravity by this method becomes a comparatively simple matter as far as theory and principle are concerned. In the practical execution of the work there are difficulties that make it one of the highest precision, and at the same time one demanding the greatest care and attention to details.

In all pendulum experiments for the determination of gravity, whether relative or absolute, it is evident that the pendulum must swing under precisely the same circumstances, or the observations must be reduced to what they would have been had they been made under the same circumstances. The principal influences bearing on the duration of an oscillation, and those which vary most from one station to another, are the changes in the rate of the time-keeper, those resulting from differences in amplitude of the oscillations, and those dependent on the temperature of the pendulum and the pressure of the surrounding atmosphere.

The first two are readily disposed of, as one is independent of the pendulum and the other is a question of simple geometrical relations. The influence of the temperature may be determined either by swinging in great ranges of temperature and noting the changes in the period of oscillation for the two conditions, or by measuring the increase of length of the pendulum for a given increase of temperature and resorting to computation for the effect of this increase of length on the time of an oscillation. The pressure correction, or at least as much of it as is dependent on the buoyancy of the atmosphere, may likewise have two independent determinations. A part of this correction comes from the influence of the air that is set in motion, and depends on its viscosity. But the whole atmospheric effect may be eliminated from the length obtained for the seconds pendulum by using a reversible pendulum whose external form is symmetrical with reference to the centre of figure. The Coast and Geodetic Survey pendulums devised by Assistant C. S. Peirce are so made. Two different lengths are also used, one yard and several metre pendulums having been made at the Coast Survey Office in 1881. These instruments have been swung in many parts of the United States, from Boston in the east to San Francisco in the west, and from Albany in the north to Key West in the south. Besides these experiments, which were nearly all made near the sea-level, comparatively speaking, many determinations have been made at higher elevations in order to study the effect of distance from the earth's centre, and the attractions of mountains and table lands lying between the station and the sea-level.

In order to connect our series of pendulum observations with similar work done in Europe and other parts of the world, several of the principal pendulum stations in Europe were occupied with a Repsold reversible pendulum, and the same was swung also at some home stations. Also the Kater invariable pendulums,

brought to this country by Captain Herschel, and which had been swung in different parts of the world, were swung at several of our stations as well as in New Zealand, Australia, the Malayan Peninsula, and Japan. The Coast and Geodetic Survey has thus secured an intimate connection with pendulum research the world over.

Outside our own country the Peirce pendulums have been sent to Lady Franklin Bay with the Greely expedition in 1882, to the South Pacific Ocean with the solar eclipse expedition of 1883, and to the Hawaiian Islands at the request of their government in 1887. In this last voyage both a yard and metre pendulum were swung at an elevation of ten thousand feet, and also at two stations at the sea-level. All this foreign work was done either by an officer of the Survey or by a trained observer following the most approved home methods.

The swaying of the stand on which the pendulum rests necessitates another correction to the time of oscillation in the case of absolute determinations. This source of error has been investigated mathematically by Professor Peirce. The English have used a small inverted pendulum attached to the stand for determining this correction.

The determination of the figure of the earth is one of the objects of pendulum observations. The force with which bodies attract each other depends on the quantity of matter in them and their distance apart. Places on the earth, therefore, which have an excess of matter, either from the material being of greater volume, or of greater density, will show a corresponding increase of the force of gravity; and places near the pole, from their being nearer the centre of the earth, would be expected to show a variation in the force of gravity in the same direction. Hence gravity determinations made at different points, starting from the equator and going towards the poles, will show the relative distances from the centre, and from this, with the aid of Clairaut's theorem, the shape of the earth. This would give a general figure for the sphere. Besides this, the pendulum will determine irregularities in this figure. In general, the result of pendulum observations thus far seems to indicate that gravity is in excess at island stations and coast-lines, and in defect on mountain tops; but this last may be partially due to the sea-level being raised in the neighborhood of continents by the attraction of the land, and the former is certainly influenced by the attraction of the surrounding sea-water. At any rate mountain observations point towards the conclusion that there may be either immense subterranean caverns beneath, or that the mass may be composed of lighter material than the earth's crust generally; and it may likewise be inferred that the stratum forming the bottom of the ocean is composed of comparatively heavy matter.

There are shown in this exhibit two reversible pendulums which have been used in the observations above described. One is a Peirce reversible metre pendulum swung in the heavy wooden frame devised for it by Professor Peirce, who has found it necessary to discard metallic stands. The other is the Repsold reversible metre pendulum referred to above. It is mounted now as it was when used, except that certain parts not necessary for showing the pendulum oscillations are omitted.

ENGLISH RAILROAD SPEEDS.

IN a recent letter from Manchester, England, to the *Railroad Gazette* of this city, Mr. W. H. Booth says that so important have been the changes made in the passenger traffic of all the great English companies, and also so numerous, that 'Bradshaw,' guide to all British lines, did not appear until the 3d of July. The alterations, of course, as usual, date from July 1, and call for special notice. 'Bradshaw' is studied with especial zeal just now by old established travellers, for the numerous changes have quite overthrown their knowledge. All the three companies which conduct a traffic between London and Scotland have added new expresses or increased the speed of existing trains, and the train service between the large towns has also been greatly improved and accelerated. For some time past American superintendents of motive power, and master mechanics, have been priding themselves upon running a good second to their English colleagues, and even ven-

turing to hint that they would soon pass them. Now, however, as usual with all changes in England, the progress there has taken a great step forward, and even the lines south of London, or more properly speaking, of the Thames Valley, are waking up, and the French also have ventured to reduce the time of the Calais and Paris express some fifteen minutes.

The fastest train between London and Edinburgh has hitherto been the Great Northern, from King's Cross, and it has performed the journey of 396 miles in nine hours. This same train now performs the distance in eight hours and a half, and of this time there are twenty minutes taken up for lunch at York, so that the run is seen to be very excellent indeed. On the other hand, the Northwestern, which has hitherto done the 401 miles between London and Glasgow in ten hours, has knocked off a whole hour, and runs the distance in nine hours, at a speed of forty-four and a half miles per hour, including stoppages, which consume forty-five minutes. Hence, while running, the speed is over forty-eight and a half miles per hour. Of the distance of 401 miles, 190 are over the hills of the Lake district and the Scottish Lowlands, but are covered at the same speed, about forty-seven miles per hour. The Northwestern line has to climb to an elevation of 870 feet over Shap Fell, and the Caledonian sixteen hundred feet at Beattock, with long grades of seventy and seventy-five feet to the mile in both cases. The Midland, again, which attains an elevation of fifteen hundred feet near the head of the Eden Valley, and has a large number of severe curves and gradients, runs 423 miles between London and Glasgow in nine hours and twenty minutes. This is really a better performance than that of the Northwestern, for one of its trains runs twenty-two miles further in only twenty minutes more time. Of the sixty minutes reduction in time by the Northwestern train from Euston station, it is remarkable that the whole of it is taken out of the running time, for the stops are as frequent and as long as before.

The 250 miles between Manchester and Glasgow are completed in five hours and fifty minutes, with six stoppages.

Between Manchester and London there are run daily no fewer than forty-two trains, which maintain a speed, including stoppages, of over forty miles per hour, and as many as twenty-seven similar trains between London and Liverpool. From London to Manchester is 203½ miles, and the shortest time is four and a quarter hours, by the Great Northern, with a climb of a thousand feet, in Longdendale near Penistone. This run includes a stop of five minutes at Grantham and of four minutes at Sheffield. The time of this train is three hours and twelve minutes to Sheffield, which is 162½ miles from London. The speed is thus close upon fifty-one miles to Sheffield, or, deducting a stop of five minutes at Grantham, over fifty-two miles per hour, and this allows nothing for the slacking off at stops and the time lost in attaining full speed, this loss being always considerable with the large-wheeled engines used in England.

These fast English expresses are by no means light trains: the Scotch expresses especially are long, fully loaded trains, and the speeds attained with regularity and punctuality as well as economically as regards fuel, ought to receive attention on this side of the Atlantic, where it is the fashion to believe or pretend to believe that English locomotives are inferior machines, and universally provided with rigid wheel base, and unprovided with either bogies or other means of axle radiation.

The incorrectness of this assumption is shown by the following facts. The three routes to Scotland are worked by the somewhat different types of locomotives owned by four English and three Scotch railways. One company, the London and Northwestern, employ a single pair of wheels in radial guides under the front end of the engine. Another, the Great Northern, use a four-wheel truck with cylindrical centre pin and no lateral motion, and the five others employ the Adams four-wheel bogie, which has practically universal motion, the centre pin being a portion of a sphere, and the lateral motion being regulated by adjustable springs instead of with links as in American trucks. Thus none of the heavy express engines running these important trains have a rigid wheel base.

Of the seven types of locomotives used, two are compound, one is outside connected, and the other four are inside connected. One has a single pair of drivers, one has four drivers but no coupling

rods, being on Webb's system, and the other five have four coupled drivers.

Considerable difference of practice exists with regards to the means of enabling the carriages to pass round curves. All the routes use, more or less, six-wheel carriages, with from eighteen to twenty-one feet wheel base, the boxes having some lateral motion in the pedestals or axle guards as they are called. The standard practice of the London & Northwestern is, however, an eight-wheel carriage, the end wheels having a radial motion controlled by springs. The Midland uses American pattern six-wheeled trucks under long passenger carriages, and four-wheeled bogie, with independent semi-elliptical springs above each journal box, dispensing with the heavy equalizer and in some cases with bolster springs. Two other lines use trucks under long carriages only, and the others adhere generally to the six-wheel arrangement as being lighter and simpler, though the motion round curves is not so smooth.

A compound engine of Webb's system, and made by Beyer, Peacock & Co., of Manchester, will soon be tried upon the Pennsylvania. As many of the fastest English trains are run regularly by engines of this type, it will be of interest to note their performance on American lines. Should the engine prove a failure, the cause certainly cannot be laid to the engine in the face of the scheduled speeds in 'Bradshaw,' which are not merely speeds on paper but represent what is actually performed. Possibly the inferior quality of American coal may be found unequal to supply steam in an English fire-box, which, for the work done, is generally smaller than in America. If this is not the case, there can be no reason for failure, apart from unskilful handling. With such an example of speeds before them is it not time that American trains made faster running than they do? England is a small country, and yet the English, who work much shorter hours than the Americans do, and must necessarily spend far less time in travelling between their large cities, are not satisfied unless they travel at the very highest possible speed. They certainly waste a half hour in stoppages during a run of eight and a half hours, mainly for dining. Actually therefore, they run four hundred miles in eight hours, and so would cover the nine hundred miles from New York to Chicago in eighteen hours, if they would dine on board the train. Travelling in England is very much simpler than in America. The use of sleeping cars is hardly necessary. Every important journey in the country is performed in less than nine hours, and the majority of the long journeys do not consume five hours. Hence sleepers and dining cars are a superfluity, with which few travellers in England care to be annoyed. In the United States they are indispensable, and perhaps their use has had something to do with the slowness of American trains.

SCIENTIFIC NEWS IN WASHINGTON.

The Topographic Maps of the United States Geological Survey; what They Are and What They Show. — The Proposed National Zoological Park; its Location and the Advantages of the Site. — How the Japanese Ferment, 'Koji,' is Made.

The United States Geological Survey's Topographic Maps.

"WHAT business has the United States Geological Survey to be spending the money appropriated for its work in making topographic maps on large scales?" is a pertinent question that is often asked, and more frequently of late since the Survey, in co-operation with some of the States, is rapidly pushing forward the work of mapping the area of those particular States to completion. "Why does not Major Powell, the Director of the Survey, send out his geologists to study, arrange, and represent on a geological map the rocks and minerals of the country, and let somebody else indicate on maps the hills and valleys, the forests and streams, the roads and towns?" This question contains an implied criticism of the management of the United States Geological Survey that is heard in Congress every session, and is repeated by men both in and out of government employ who think that the Survey is overstepping the limits fixed for it by law.

This question has been answered more than once, but it has been in testimony given before a commission or a committee of Congress, that never had a popular circulation, and which, if it had, is so voluminous and mixed up that very few persons would suc-

ceed in getting any definite information from it. Preliminary, therefore, to a description of these maps, and preliminary to an enumeration of some of the practical uses which they have, the question as to the authority for making them should be answered.

It is the purpose of the Director of the United States Geological Survey to make the geological map of the United States a practically useful one. It will not only show the character, extent, and positions of the rocks that underlie the surface, in a general way, but it will aim to show them exactly where they are in nature, and their relation to the surface of the ground, so that a person in possession of one of these maps may go and find the outcrop of any particular stratum, if it has an outcrop, learning from the map whether it is at the top or on the side of a hill, or in a valley, and its relative position, not only to other strata, but to the prominent landmarks of the adjacent country. But, in order to locate the geological features of a section of country accurately, it is necessary to have an accurate map showing the topographic features of the section, and no such maps had been made until the United States Geological Survey took up the work.

The topographic maps now being made are to be the basis of the geological work. Without them the latter would be in great degree useless. The preparation of them is the necessary preliminary work to the geological survey, and, as Major Powell's bureau is authorized to make a geological map of the United States, that authority necessarily implies authority to do the necessary preliminary work.

But good topographic maps, even when made primarily to be used as the basis of a geologic survey, have an incidental value in many other ways, and it is entirely proper, it is very desirable, indeed, that they shall be utilized in every possible manner. Not a single state, except two which will be referred to later, has to-day even a fairly good map of its area. The best are inaccurate and show little or nothing of the topography. The river courses, the larger ponds and lakes, and the higher hills or mountains are approximately located upon most of them, but aside from these more prominent features they give no idea of the character of the face of the country. Where roads are laid down there is generally nothing to show whether they extend over a rolling, hilly, or flat country; and any one who should attempt to drive across the country with one of the best of these maps as a guide is pretty sure to get lost and have to inquire the way. In many of the existing maps the culture, that is the houses, with the names of their owners or occupants, and other transient features in which individuals are interested, are given with considerable detail, but many permanent natural features are omitted. The former make a map sell; the latter make it of practical use in a hundred different ways.

Several of the States, recognizing the importance of having good maps of their areas, have appropriated money for that purpose, and commissions have been appointed to supervise the work of making them. But, as it is the purpose of the United States Geological Survey to make topographic maps of the entire country as bases for its geological maps, and as it has the instruments, trained expert topographers, and an organization perfected by which maps can be made much cheaper and better than they can be made by any special force organized for that purpose, it is an obvious economy for the States to employ the Geological Survey to make these maps, even though they have to pay the entire expense of them, rather than to attempt to do it themselves.

The general government also derives a direct benefit from this co-operation. If the States do not make topographic maps of their areas the United States Geological Survey will do so for its own purposes. If the States do make the maps, but make them in their own way, they will not be uniform with those made by the Geological Survey or with each other, so that, while they may be very good maps, they will be of much less use in making a geological map than if the uniformity referred to was preserved. In fact, the United States Geological Survey would eventually have to go over the same ground and make its own maps. On the other hand, if the money appropriated by the States for map making is paid over to the Geological Survey and used as far as it will go in paying the expenses of making the maps, the cost to the general government of getting such topographic maps as it needs is reduced by the amount of the State appropriations, and the expense to the States

is lessened by the amount that the general government contributes.

Three States have thus far availed themselves of the opportunity to co-operate with the United States Geological Survey in making topographic maps of their areas,—Massachusetts, New Jersey, and Rhode Island. The maps of the first two have been completed and are now in the hands of the engravers. For each State there will be a large atlas of beautiful copper-plate sheets showing with almost absolute accuracy the location of every natural feature of the country, the altitude of every point, and, by contour lines, the steepness of all hills, the positions of cities, towns, villages, and post-offices, the courses of the roads, railroads, canals, etc., and, in general, every thing that is permanent in its character as distinguished from that which is temporary, or of individual rather than general interest.

The topographers are now in the field at work upon the Rhode Island map, and it will be completed this season. The area of the State is about eleven hundred square miles, and of this about four hundred square miles has already been mapped, leaving about seven hundred square miles still to be done.

Besides the work in these three States, the United States Geological Survey has made topographic maps of the Appalachian belt extending through parts of the States of Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Kentucky, and Tennessee. Work has also been done in Missouri and Kansas, and a large area in those two States has been mapped. A party has been at work for two years around Fort Smith in Arkansas, and about four thousand square miles have been mapped in Texas. Around Madison, Wis., a small area has been surveyed for the benefit of Professor Chamberlin's work on glacial geology, and an experimental start has been made in Iowa. This work has all been done by the United States Geological Survey without the co-operation of the States. Some work has also been done in the Rocky Mountain region supplemental of that of the Powell, Hayden, King, and Wheeler surveys, which was done before the United States Geological Survey was organized, but which will be utilized.

The topographic maps of the United States Geological Survey are made upon three different scales. In the first, or smallest scale, one unit of distance on the map represents 250,000 units of distance in nature, or four miles in nature is represented by one inch on the map. The second scale is twice as large as the first, or 1 to 125,000,—two miles to an inch,—and the third one-fourth as large as the first, or 1 to 62,500,—one mile to an inch. In the maps of the smallest scale an atlas sheet, when it is engraved, will represent an area included within one degree of latitude and one degree of longitude. If the second scale is used there are four atlas sheets to a degree, and when the largest scale is employed it requires sixteen atlas sheets to cover one degree of latitude and one degree of longitude. The maps of Massachusetts, Rhode Island, and New Jersey are made upon the largest scale.

The question as to the best scale for maps and the minuteness of detail that it is wise to attempt to represent has been a great deal discussed by map-makers, but no agreement has been reached. The publication scale of the United States Geological Survey maps and the size of the sheets which the topographers use in the field have necessarily no definite relation to each other. Some men do better work upon a large than upon a small sheet, but the tendency is, with every year's experience, to work nearer and nearer to the publication scale; that is, to put into the original map all that can be shown on the engraved sheet without confusion, and to omit other details.

The questions that are asked the topographers when they are in the field disclose the particular features of a map in which the people are most interested. For instance, in Rhode Island great interest is manifested in the development of water power and also in regard to the altitude of the higher hills of the State. In explanation of the frequent question whether this hill or that is not the highest in the State, it may be said that a great many of the farmers of Rhode Island are becoming more dependent upon summer boarders than upon the products of their generally sterile lands for their support, and every one whose house is on the top of a hill would like to be able to say that it is on the highest point in the State. How little was known about the relative altitudes of the

hills of Rhode Island is shown by the fact that in the report of the State census of 1885 several hills are mentioned each of which has been asserted on what was supposed at the time to have been good authority to be the highest in the State. The greatest altitude of all of these, that of Woonsocket Hill, was given as 570 feet. The United States Geological Survey engineer who has been running levels over the State found that the altitude of the road across Chopmist Hill is more than 700 feet. Chopmist Hill was not in the State census list.

The United States Geological Survey topographic maps have already been found to be of great practical use in locating roads and railroads, and in the development of the mineral resources of the country. The illustrations of this are constant and numerous. General Wilder of North Carolina was interested in a projected railroad from Charleston, S.C., to a point in North Carolina to reach which it was necessary to cross a mountainous country. After examining the maps of the region made by the United States Geological Survey he said that they were worth ten thousand dollars to his company. They showed that the route they had contemplated was impracticable, and to have ascertained that by a special survey would have cost the sum named. The Canadian Pacific Railway Company made four trial surveys before its engineers were able to select the best route across the Rocky Mountains. The cost of these trial surveys was three million dollars, a sum that would have paid for making a topographic map of the whole region upon a four mile to an inch scale, and such a map would have shown the best practicable route at a glance. As these surveys are extended over greater and greater areas their uses will multiply. The Great West has developed much of its resources in advance of the map-maker; the New South, more fortunate, will have the aid of the map-maker, and consequently will develop its mineral resources and lay out its railroads at much less expense.

A question that is constantly asked at the United States Geological Survey office is, "Have you a map of such or such an area, and if so, where can I get a copy?" The answer that has to be given, when the area referred to has been mapped, is that no provision for publishing the map has been made. The organic law of the Survey does provide for the sale of its publications, but the topographic maps are not, in law, complete work. They are only data or material for the use of the geologist. It is not necessary, in order that they shall be available for geological work, that these maps shall be engraved, and by no other method of reproduction can copies for popular use be satisfactorily made. It is to be hoped that Congress, appreciating the value to the people of these maps, will authorize them to be engraved and copies of them to be sold at cost. In cases of State co-operation provision for the reproduction and distribution of the maps is made by the legislature.

The Proposed National Zoological Park.

The Senate has added to the sundry civil appropriation bill a provision for a national zoological park on Rock Creek, in the suburbs of Washington. The site selected is one of the best for such a purpose in the country. Through the centre of it winds Rock Creek, a most picturesque little stream, from the banks of which, on either side, rise a series of beautiful hills covered with fine timber. The tops of many of these hills have already been selected for villa sites, and a great number of beautiful suburban residences have either already been built or are in contemplation. The system of street railways is to be extended from the city into this section, so that the proposed park will be easily accessible by a short and pleasant ride, while the drive to and through it will not be surpassed in beauty by any in the suburbs of any other American city.

The area of the proposed zoological park is about one hundred and twenty-one acres. About three-fourths of it is covered with forest, and although its length is only three-fourths of a mile, the course of the stream in passing through it is more than a mile and one-third. It is believed that the entire tract can be purchased for less than two hundred thousand dollars. The distance from the White House to the proposed entrance to the park is but a little more than two miles.

In the National Museum the general government has provided

for the preservation of objects representing the archaeology, geology, mineralogy, and flora of the country, and its progress in the arts and sciences, and the Senate has already approved a measure providing for an additional building, which, when completed, will more than double the exhibition space now available. But the fauna of this country is becoming extinct more rapidly in many of its branches than any other of its interesting aboriginal features. Some species of animals have already disappeared from sections where they formerly were plentiful, and others are now but rarely found. No provision has ever been made for the preservation of specimens of these native animals; no provision can be made except by the government of the United States, and not even in the way now proposed if there is much longer delay. If Congress acts promptly in authorizing the establishment of a national zoological park, specimens of animals that have already become practically extinct, although they were numerous when America was first settled by Europeans, may yet be obtained, and in time the entire fauna of the country may be represented. It is hoped that the House of Representatives may agree to the moderate appropriation for this purpose proposed by the Senate.

Preparation of Japanese 'Koji.'

In response to a request from Dr. W. M. Murtrie, professor of chemistry in the University of Illinois, the State Department has obtained from Prof. C. C. Georgeson of the Imperial Japanese Agricultural College at Tokio an account of the method of preparing the peculiar ferment called 'koji.' It is made, Professor Georgeson says, both in 'sake' breweries and 'koji' factories, and one of the essential conditions of its production is that an even temperature shall be preserved in the fermenting rooms. In 'koji' factories these apartments are usually fifteen or twenty feet underground, in some sufficiently dry place, and are reached by means of a shaft, while in 'sake' breweries these chambers are frequently arranged in ordinary buildings, the walls being lined with straw mats and mud to prevent radiation.

The materials used are water, rice and 'tane' (seed or leaven). The rice is the common starchy kind known as 'uruchi.' Glutinous rice ('*mochigome*') is not used. The 'tane' is the spores of a fungus, *euotium oryzae ahlb.*, and occurs as a yellow powder, which, at a certain stage of the process, is mixed with the rice. It is the substance which, in germinating on the rice grain, changes part of the starch into dextrose and dextrin, and gives it the properties of a ferment.

The rice is first thoroughly cleaned and the thin covering ('*testa*') of the seed is removed. If this is not done the liquids with which the 'koji' is mixed would be inclined to putrefy. The rice is then washed by stirring it in a tank of water till all the dust and adhering fine particles are floated off, after which it is steeped for some hours to soften the grain.

The steaming may be done in the ordinary way by means of a steam boiler, although the Japanese method is much more primitive. When this is completed the rice is spread upon straw mats to cool. When the temperature has fallen to 98° or 100° F. the 'tane' is sown upon the mass and thoroughly mixed with it. The thorough and uniform distribution of the 'tane' is more important than the exact quantity used. The amount is generally 1½ to 2 cubic centimetres per bushel of steamed rice. The 'tane' used in most factories is obtained in Osaka, but as to the manner of its production Professor Georgeson says he is not fully informed. So far as he can learn, however, since those who produce it keep their methods secret, the rice impregnated as described above will in due time mature the plant, and the spores will form on the surface of the grain as a yellow powder. When the crop is ripe, the rice is dried, spread upon paper, and then stirred or rubbed until the spores are detached by attrition and collected on the paper. The 'tane' is said to be produced chiefly in winter.

In the production of 'koji,' after the 'tane' is mixed with the rice the mass is allowed to remain in bulk eighteen or twenty hours, being simply covered with mats. The temperature of the room is not kept high at this stage. The next day the rice is distributed into shallow wooden trays, each holding about three litres, and spread in a thin layer on each. These trays are then carried to the warmest room, where the minimum temperature should not be

lower than 75° F., and here either placed on shelves or piled one on the other on the floor. In some cases the rice is sprinkled with water and left standing in baskets several hours before it is distributed on the trays. In other cases the trays are not placed in the warm room until toward evening of the second day (the day after sowing the 'tane'), and they are then left undisturbed until early in the morning of the third day. When the rice is not moistened the trays are left standing only four or five hours, when the contents of each must be thoroughly stirred by hand, which process is repeated after another four hours of rest. At this stage the fungus grows rapidly and much heat is evolved; the grain becomes opaque, assuming a fibrous texture and becoming somewhat sour in taste. After from four to ten hours the trays are emptied of their contents and the rice spread thinly on mats to cool. It is then 'koji.'

There is a loss of weight during the process of from ten to twelve per cent of the rice used. This is due to the evolution of carbonic acid, which makes the ventilation of the room necessary in order to make it possible for the men to remain in it. The usual mode of ventilation is to insert a perpendicular flue, which can be opened or closed at pleasure, extending from the ceiling to the outside air, and an inclined or horizontal flue which discharges fresh air near the floor.

ELECTRICAL SCIENCE.

A New Diffusion Photometer.

MR. J. JOLY has brought out a new photometer which is simple and sensitive. One form consists of two parallelepipeds of paraffin of equal dimensions, planed smooth so they can be laid accurately together on similar faces. Putting these together with the plane of discontinuity at right angles with the line joining the lights to be compared, the compound block is moved toward one or the other of them until the fine line of division between the two pieces almost or wholly disappears. The distances from the lights to the plane of discontinuity are now measured, and the relative intensities reckoned as inversely as the squares of the distances. In the case of lights of dissimilar colors the appearance of the photometer is no longer uniform, but that of two softly glowing substances of different colors. Even under these circumstances, if the colors are not greatly different a point of minimum distinctness of the line can be found with considerable accuracy. The greater sensitiveness of this photometer over some of the other forms used is due to the fact that we have to concentrate all of our attention on the line of junction only, not on two images at some distance apart. Instead of paraffin, glass of a translucency approaching that of paraffin may be used, and the effect may be heightened by interposing between the two pieces a sheet of silver foil. The dimensions that Mr. Joly finds best are 20 by 50 by 11 millimetres for each parallelopiped. They are laid together on two of the larger faces, the parallel external faces being ground smooth, but left unpolished. The surface under observation during the experiment is ground smooth and polished after joining the parallelopipeds. The most important points to be attended to in their construction are fineness of division line and uniformity in thickness. Should there be any difference in the translucency of the parallelopipeds a check observation might be made by turning over the photometer so that the halves change places relatively to the lights, taking the mean of the observations. This is, however, rarely necessary. This compound block is mounted in the same way as an ordinary Bunsen photometer, and the same precautions are necessary in using it.

ELECTRIC TRACTION ON THE UNDERGROUND ROADS IN LONDON.—Nowhere can electricity be more easily employed for traction work than on the underground roads that are to London what the elevated roads are to New York. The rational method of employing it is to use motors supplied from an overhead wire, the electricity being generated at stations along the lines. The objections sometimes urged against the overhead system for use on city streets cannot apply here, and there would be little doubt of the economy of the system, besides the great advantages it would possess as far as ventilation and comfort went. Instead of using a direct current, however, it is proposed to employ storage batteries on the train. The motors are to have a capacity of 600-horse power, and when one considers the difficulties that have been ex-

perienced in getting a battery of reasonable weight that will give a maximum output of ten or fifteen horse power for ordinary tramway work, it would seem that the plan is almost certain to fail. A hundred tons of battery might be sufficient, but with the initial cost of it, its deterioration, and the power that must be expended to draw it, the chances for the economical working of the system are small.

TRANSFORMERS BASED ON ELECTROSTATIC INDUCTION.—M. Doubrava has described a method of reducing currents of high potential and small quantity to those of low potential and great quantity by means of electrostatic condensers. He first charges a condenser of comparatively small capacity to a high potential, then disconnects it from his line and discharges it into a condenser of great capacity, thereby lowering the difference of potential between the coatings, and finally he discharges the large condenser into the lamp-circuit which he wishes to feed. By performing this operation fast enough a practically continuous current is obtained in the latter circuit. While the general idea of using condensers for transforming high to low potential currents is not new, and while methods have been proposed which seem as promising as that of M. Doubrava, yet his system has in it some elements of novelty. The difficulty lies in the great capacity of the condensers that will be required. Taking the charges and discharges as rapid as seems practicable; the condensers—supposing the distribution is at 200 volts—would have to have a capacity of about 1,000 micro-farads for every horse-power transformed. Now a condenser of 1000 micro-farads capacity is enormous, and would be expensive to build and too large to conveniently store. The efficiency of the system would be, probably, very high, but it would require rotating apparatus of some description, which, with the fact that house to house distribution at high potential would be dangerous, would necessitate the distribution of the low-potential currents from substations. When one tries to imagine a sub-station distributing 500-horse power, with a condenser of a capacity of 500,000 micro-farads, the system will seem a doubtful one.

ALLOYS FOR ELECTRICAL RESISTANCES WITH NO TEMPERATURE CO-EFFICIENT.—Mr. Edward Weston has discovered an alloy whose specific resistance is high and whose resistance is not affected by temperature changes within ordinary limits. This is valuable for electrical resistances, and will doubtless have an extended use. The alloy is a mixture of copper and manganese. It may be made from copper and ferro-manganese in the proportions, copper 70 parts, ferro-manganese 30 parts. A still more curious alloy is made from copper 65 parts, ferro-manganese 25 to 30 parts, nickel $2\frac{1}{2}$ parts. This possesses the remarkable property of decreasing in resistance as its temperature rises, a peculiarity heretofore ascribed to carbon and electrolytes only. This last alloy can be used with ordinary copper or German silver coils in such proportion as to cause the total temperature co-efficient to be zero. It is to be hoped that these substances will be carefully studied and their properties at high and low temperatures determined.

CHEMICAL ACTION IN A MAGNETIC FIELD.—Since 1881, when Professor Remsen discovered that the deposition of iron was affected by a strong magnetic field, experiments have been tried to determine the nature of the effect of magnetism on chemical action. The latest and most satisfactory contribution on the subject is that of Prof. H. A. Rowland and L. Bell, in the current number of the *American Journal of Science*. Their general method was to take two pieces of the metal to be experimented on, put them in circuit with a galvanometer, and immerse them in an electrolyte between the poles of a powerful magnet. The two pieces were covered with wax except at two opposite points, where they were bare, and by changing the shapes of the uncovered portions the condition of their surfaces with respect to the rate of change of magnetic force could be varied. For instance, in the first experiment that was tried pieces of iron were immersed in dilute nitric acid. One of the bare surfaces was flat, the other filed to a sharp point. If there was no deflection of the galvanometer when the circuit of the magnet was made, there was a sharp throw immediately on making the circuit, the needle then gradually returning to zero and going past to the other side. The throw was in a direction as if the sharp point was copper and the flat surface zinc. When the point was

filed off, there was no throw. Thirty substances were tested as electrolytes. They in general showed the above phenomena, excepting that the acids which evolve hydrogen when electrolyzed showed it very feebly. Experimenting to find the cause of the gradual reversal of the deflection after the first throw, it was found that any agitation of the liquid produces the same effect, and that when diffusion was prevented, by using fine sand in the vessel or by using gelatine with the solutions, the first throw only remained. The small effect with the hydrogen-evolving acids is probably due to the mechanical protection of the point by the bubbles of gas. Cobalt and nickel were tried and found to give similar effects but smaller. From their experiments the authors come to the conclusion that the particles of magnetic material on the plates are governed by the general laws of magnetic attraction and are held in place against chemical action as they would be against a mechanical force. The rate of change of force at a point is, of course, greater than that on a plane surface, hence the metal on the point is to some extent protected against chemical action, and acts as the electro-negative metal in the circuit. The general rule stated is as follows: When the magnetic metals are exposed to chemical action in a magnetic field, such action is decreased or arrested at any points where the rate of variation of the square of the magnetic force tends to a maximum. The authors criticise a paper on the same subject by Professor Nichols of Cornell, whose results are directly opposite to their own, as far as the two experiments touch. They claim that besides giving no explanation of or drawing any deduction from his results, he has in some cases mistaken disturbances for the real phenomena. The paper seems to explain the phenomena simply and naturally without the help of new relations or hypotheses.

BOOK-REVIEWS.

L'art et la Poésie chez l'enfant. By BERNARD PEREZ. Paris, Ballière. 8°.

THE English translation of Perez's 'First Three Years of Childhood' has familiarized the English-reading public with the general plan of work and method of treatment of this French psychologist and educator. M. Perez is imbued with the idea that the unfolding of mental processes that goes on in every child and is so often the subject of literary effort can yield material for the scientific study of an important chapter in psychology. This psychogenesis in part changes its character with the relative importance of the natural and the artificial elements in the child's education, with the nature of the civilization that forms its environment, with hereditary and individual characteristics. These varying conditions affect differently the various psychological elements that go to the making of a human being, and make necessary different methods of study. In the chapter of 'Infant Psychology' that M. Perez now brings to notice, these varying conditions are of supreme importance; so much so that it seems impossible in some respects to describe the artistic efforts of children, but only of certain children. Nevertheless the path of progress is in so many respects similar, and the directions of artistic interest so unchanging in spite of national and other influences, that one feels something generic even if vague to be at the basis of it all. Again, that close analogy between the development of the individual and that of the race does not lose its application here. It is true that primitive art is far from all being alike, that the art of civilization of which it was the predecessor is no less variable; but from a psychologic point of view the development is generically alike in all cases. For example, we find that the excessive and gaudy decoration of the body is displayed by savages and young children; we find them preferring the same loud, boisterous airs in music, and equally lacking in a sense of the beauties of nature. We see, too, how the subject of serious use and adornment in one stage of civilization degenerates into a toy for the children of the succeeding stage; witness the drum, and the bow and arrow.

A survey of the many paths along which children find their way to the pleasures of art can be most easily attained by a *résumé* of the chapters of the volume before us. In the first chapter are treated the many forms of personal decoration visible in the toilet. We know how soon a child takes an interest in its costume.

how for girls especially the doll is valuable because it is a dressable article; and has not Lotze said that in the exaltation of the ego that is produced by the donning of a new dress is the root of self-consciousness? Taste in this direction is seldom good at first, but it takes its character so entirely from the environment that the psychologist can do little more than record the shifting of interest from one point to another that proceeds as the child matures. In the feeling for the beauties of nature, — the emotions inspired by the graceful, the sublime, the pleasures that flowers and scenery bring, — we have a higher and a later form of artistic interest. M. Perez describes very pleasantly, even if at times prolixly, the growth of these sentiments in different children of his own acquaintance, and records the corresponding descriptions in the autobiographies of eminent men and women. On the artificial side we have the growth of the social instincts, the art of making oneself agreeable, politeness, coquetry, and so on. In France at least this seems to develop precociously early, but the social position of the family must everywhere be the chief factor in its culture or neglect. Passing to the fine arts proper, music is doubtless to be accorded the foremost rank. We know that the most wonderful instances of precocious talent are to be found amongst musicians, and this is in many cases the first artistic pleasure that the child has. The human voice is a source of much pleasure to the child. The distinction between the soothing and the exciting forms of music is soon appreciated. The educational value of rhythm is recognized by all kindergartners. The many decorations of bones, of rocks, of pottery, by primitive peoples are not unlike the first scratches of a child. The things most frequently delineated are quite alike. Given a child, a lead pencil, and some paper, and the result can be predicted, with due allowance to the nationality and other circumstances of the child.

The play instinct is a very potent factor in the growth of artistic taste; performing on a musical instrument as well as acting still go by the name of 'playing.' Foreign personalities are so real to the child, his vivid imagination so easily assimilates them, that 'pretence,' acting, is a common and an early childish trait. The doll is the central figure about which the most thrilling dramas are composed and enacted; to the boy the putting on of a paper helmet and a wooden sword is enough to make him a soldier in thought and deed. Children act to court admiration, and with a normally weak distinction between fact and fiction goes a fondness for acting out what has originated in the realm of the imagination. Literary art is the latest of all acquisitions; but the first letters of a child, though lacking all merit, have a deep interest to the psychologist. To each of these topics M. Perez devotes a full chapter, and succeeds in producing a book which, though not in the strictest sense scientific and certainly not exhaustive or final, is none the less a worthy contribution to an interesting chapter of 'infant psychology.'

NOTES AND NEWS.

JAMES STEVENSON, late executive officer of the United States Geological Survey, died at the Gilsey House, New York, July 25. He was born in 1840, at Maysville, Ky. A more extended notice will appear next week.

— The buildings for the Paris Exhibition have made great progress during the last five or six weeks. According to the Journal of the Society of Arts, the large machinery hall at the south end of the Champs de Mars is now considerably more than half finished, and will probably be completed in another six weeks or two months. Considerable progress has been made with the fine art galleries; but, as they were not commenced until recently, they are not nearly so far advanced as the other parts of the building. The same remark applies to the other parts of the building for the classes included under the term 'liberal arts,' on the other side of the grounds. In this last-named building it is proposed to place a retrospective collection illustrating the progress of the arts and industries from the very earliest period. On the Esplanade des Invalides, the construction of the various small buildings with which it is to be filled has been commenced. This work has been deferred as late as possible, in order not to deprive the regiments quartered in that part of Paris of their remaining drill ground for

a longer period than was absolutely necessary. The roofs and ironwork of the long range of galleries extending along the Quai d'Orsay, and connecting the Champs de Mars with the Esplanade des Invalides, are now nearly all up. The side walls of these buildings have also been constructed for a considerable portion of their length, so that this part also of the Exhibition will be finished at no very distant date. The tower which will form so conspicuous a feature of the Exhibition has now reached about half its height. The two lower stories are now completed. The first one, forming the base, extends over a considerable area, and resembles in appearance a huge, four-legged table or stand. Its height is about 250 feet, or a quarter of the whole. On the top of this is placed the second story, of about 200 feet high; and from this second story springs the tapering column of between 500 and 600 feet in height. The point now reached is the summit of the second story. Access is obtained by means of an iron staircase built into the framing of the tower; but the guides in which the lifts will work are already in place, and when the tower is finished, the various stages will of course be reached by means of these lifts. The foundations are sunk a great depth into the ground, which at this place — close to the bank of the Seine — is less suited for bearing a weight such as a tower than the limestone rock which underlies the greater part of Paris. Great precautions have been taken to render the tower safe from lightning. It forms, of course, a conductor in itself, but, to insure proper connection with the earth, at each corner a large tube has been sunk a considerable distance into the soil, and these tubes it is proposed to keep full of water. Good electrical connection is made between the tubes and the framework of the tower itself. It remains to be seen whether a building of this enormous height will carry off electricity safely in consequence of its excellent conducting powers, or whether it might not suffer from a shock of more than usual violence. The site is certainly ill-chosen to enable the tower to make the most of its height, since it is on some of the lowest ground in Paris, and in spite of the enormous height of the building itself, at the present time, its top is now only on a level with the summit of the towers of the Trocadero Palace, a building which, though much inferior in size, stands on the high ground on the other side of the Seine. The French executive report favorably as to the exhibits which they expect to receive from foreign countries. Considerable sums have been voted, among others, by various of the South American States, as well as by the United States, and by Belgium. The Spanish government, though not officially represented, has voted a large sum towards the Exhibition, and it is said that the unofficial committees in various of the European States are most of them successful in securing a representation of their several countries.

— Augusta, Ga., the largest cotton manufacturing centre in the South, is prominent among Southern cities this year, as the site of the Augusta National Exposition, to take place Oct. 10 to Nov. 17, 1888. No outside aid has been asked, and no government appropriation been made. The project is a conspicuous and commendable one in this respect. The Exposition aims to be national in scope. Many of the largest manufacturers North and West will be represented, and an extensive government display from all the executive departments and branches of the consular service are already secured. But the most complete representation will be secured of all the Southern industries and of the development of the resources of fields, forests, and mines that has taken place in the last ten years.

— The International Congress of 'Americanists' will hold its seventh session in Berlin from October 2 to 5 next. The organizing committee has just issued the programme. The first day will be devoted to questions relating to the discovery of the New World, to the history of America before the time of Columbus, and to American geology; the second to archæology; the third to anthropology and ethnography; the fourth to philology and palæontology.

— On July 9 the atmosphere in the English Channel became so rarefied that objects could be seen with extraordinary distinctness at a distance of between thirty and forty miles from Dover and Folkestone. *Nature* says that the lighthouse at Cape Grisnez, Calais, and the dome of the Cathedral, and Napoleon's Column at

Boulogne could be distinctly seen with the naked eye, and every prominent object could be picked out along the French coast. The distance from Dover to Boulogne as the crew flies is twenty-eight miles, and the column is about two miles further inland.

— We learn from *Nature* that at the next meeting of the British Association there will be a discussion in Section D on the vexed question of the formation of coral reefs. The discussion will be opened by Dr. Sydney J. Hickson.

— *Nature* states that the meeting which will shortly be held in Paris for the study of tuberculosis, under Professor Chauveau's presidency, promises to be very interesting and successful.

— The German ethnological and geographical expedition to the headwaters of the Xingu under the direction of Dr. Karl von den Steinen was expected in Rio de Janeiro early in July.

— The Sociedade de Geographia de Rio de Janeiro proposes to hold in September an exposition of geographical works relating to South America, for which the co-operation of nearly all the South American States has already been promised.

— Messrs. Ticknor & Co. announce for publication, August 4, 'A History of Presidential Elections,' by Edward Stanwood; new and enlarged edition; and 'Newspaper Libel, a Hand-book for the Press,' by Samuel Merrill, of the staff of the *Boston Globe*, and member of the bar of Massachusetts and of New York. — Lee & Shepard have in preparation 'Chips from Educational Workshops of Europe,' by Prof. L. R. Klemm; and 'Zoölogy Teaching for Beginners,' by W. P. Manton. — G. P. Putnam's Sons have just ready two books for the student of political economy and history. The first of these is entitled 'The Tariff History of the United States,' consisting of various essays by F. W. Taussig, which have already appeared in magazines or in book-form, and thus united present an almost complete history of tariff legislation from 1789 to 1887. The other is 'Industrial Liberty,' by John M. Bonham, who aims to keep in view the principles rather than the statistics of his subject, and makes an analysis of the salient political and industrial evils of our time. — Little, Brown & Co. have now ready 'The Origin of Species by Means of Natural Selection; or, the Preservation of Favored Races in the Struggle for Life,' by Charles Darwin, sixth edition, in new large type with additions and corrections. — E. & F. N. Spon, New York, announce *The Marine Engineer*, a monthly journal of marine engineering, shipbuilding, and river navigation; subscription, \$1.75; also, 'Crystal Models,' by John Gorman. Compared with others, the advantages resulting from this method become most strikingly apparent. The models are built up into form in a few seconds, and it is worthy of notice that, owing to the plating process being well-nigh instinctive, the manipulations after a short trial become almost automatic. The forms require no sticking at the edges.

— The Senate has amended the sundry civil appropriation bill by adding a grant of \$250,000 to pay the expenses of investigating the extent to which the arid region of the United States can be redeemed by irrigation. The proposed scope and extent of this investigation was fully explained in *Science* a few weeks ago.

— The United States Senate has voted to pay to the widow of the late Prof. Spencer F. Baird \$50,000 as compensation for his services as United States Fish Commissioner.

— It is proposed to celebrate in the winter of 1889-90 the sixth centennial of the foundation of the University of Montpellier.

LETTERS TO THE EDITOR.

* * * Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

A Standard Thermometric Scale.

AT its session last October the International Committee of Weights and Measures passed a resolution establishing a standard thermometric scale for the use of the International Weights and

Measures Service. As this is the result of the thermometric studies pursued at the International Bureau for several years, it seems desirable to give it a wider publicity than is offered by the publications of that bureau alone, from which these statements have been collected by me.

The standard scale adopted is, by the wording of the resolution "the centigrade scale of the hydrogen thermometer, having for its fixed points the temperature of melting ice (0°) and that of steam (100°) of water boiling under a standard atmospheric pressure. The hydrogen being taken under a manometric pressure of 1 metre of mercury, i.e., $\frac{1000}{760} = 1.3158$ times the standard atmospheric pressure." The standard atmospheric pressure is that exerted by a column of mercury (density = 13.596) 760 millimetres long at 0° C., at the mean sea-level in latitude 45° . An increase of pressure of one atmosphere lowers the melting point of ice about 0.008° .

All the thermometers used at the bureau are made of the same kind of glass, the composition of which was found by chemical analysis to be—

	Stem.	Bulb.
Silica.....	71.45	71.52
Sulphuric acid (SO ₃).....	0.74	0.72
Chlorine.....	traces	traces
Aluminium.....	1.26	1.57
Peroxide of iron.....	0.29	0.22
Lime.....	14.52	14.55
Soda.....	11.17	10.81
Potassa.....	0.30	0.37
Magnesia.....	traces	traces
Protoxide of manganese.....	traces	traces
	99.73	99.76

The exclusive use of this glass has several advantages.

1. The changes of the zero point are relatively very small, and its depression due to increase of temperature is practically a rectilinear function of the latter within the limits $-10^{\circ} + 100^{\circ}$.

2. The thermometers are comparable among themselves, and it was found practicable to establish a general formula for reducing their indications to the standard hydrogen scale. A table of corrections based on this formula is given below, but of course it is applicable only to thermometers of this kind of glass. The reduction of the indications of mercurial thermometers to a gas thermometer depends on the kind of gas used and on the glass of which the mercurial thermometer is composed.

T hydrogen = T mercury + correction.

T m	-20°	-10°	0	$+10^{\circ}$	$+20^{\circ}$	$+30^{\circ}$	$+40^{\circ}$
Corr.	$+0^{\circ}.172$	$+0^{\circ}.073$	0.000	$-0^{\circ}.052$	$-0^{\circ}.085$	$-0^{\circ}.102$	-0.107

T m	$+50^{\circ}$	$+60^{\circ}$	$+70^{\circ}$	$+80^{\circ}$	$+90^{\circ}$	$+100^{\circ}$
Corr.	$-0^{\circ}.103$	$-0^{\circ}.090$	$-0^{\circ}.072$	$-0^{\circ}.050$	$-0^{\circ}.026$	0.000

O. H. TITTMANN.

Washington, D.C., July 27.

Turner's Explorations in Alaska.

It is with no small degree of satisfaction that naturalists are regarding the publications that are appearing from time to time from the office of the Chief Signal Officer of the Army at Washington, referring, as we do more particularly, to the reports made under the auspices of that office by the Alaskan explorers. The last one of these, very recently issued, is now before us, and presents in an admirable manner the results accomplished in that region by Mr. Lucien M. Turner, during the years 1874 to 1881, who carried on his explorations there under the direction of the Chief Signal Officer, and in connection with the National Museum.

Issued in the usual Government form, this quarto volume of some 225 pages, with its twenty-six plates, makes a very handsome work. It has been entitled 'Contributions to the Natural History of Alaska,' and is the second of the series,—its author dividing its contents into six parts for treatment. Of these, Part I. presents a very short and concise general description of the regions explored, and we learn that Mr. Turner was at various times stationed at Saint

Michael's, Unalashka, the islands of Saint Paul and Atkha, at Attu, and many other points of interest. Part II., occupying about forty pages of the work, is devoted to meteorological observations, and presents in a fairly-well digested manner, the author's labors in this direction, and it is needless to add that the data here collated are not only of interest but of great scientific value. In Parts III.–VI., inclusive, the plants, fishes, birds, and mammals are dealt with, and in a very thorough manner when we consider many of the difficulties the author was obliged to overcome. Perhaps the botany of the region gained the least at Mr. Turner's hands, and it consists simply of his field-notes, added to Rothrock's list of 1867, the author stating "in this connection that of all great difficulties the most troublesome was to preserve the plants after I had collected them. The constant moisture of the climate has frequently ruined my entire collection of a summer's work. All that remained after supposing the plants were sufficiently dried would be a mass of mould and dry edges of paper, this being apparently done in less than forty-eight hours' time."

A frog (*Rana sylvatica*?) was the only reptile collected; and at Fort Yukon, just within the Arctic circle, this species is reported to be quite plentiful. Some excellent work was accomplished in ichthyology, and a number of species added, new to science, and several rare forms collected. Fourteen beautiful plates of fish are given, and one of a lamprey (*A. aureus*), and it would be not easy to overestimate the interesting and valuable field-notes here presented. Habits, uses, geographical ranges, and other matters, are treated with distinguished ability, and in this, much is due to the assistance of Dr. Bean of the Smithsonian Institution.

What we have just said in reference to the ichthyological part, applies with more than equal force to the work done in ornithology; and to state the fact that no less than ten elegantly colored plates of birds by Robert and John L. Ridgway are given, is equivalent to saying to ornithologists and others, who may not yet have seen the work, that a feast for their eyes is still before them. The whiskered auklet (*S. pygmaus*) is figured in full breeding plumage; Turner's ptarmigan, male and female, are both given; excellent figures of the Lapp and Hawk owls, and others of special interest. Through the published field-notes much has been added to our knowledge of the habits of many of these arctic bird forms.

No mammals, unfortunately, are figured, and this part of the report has evidently not received the attention it so justly deserves, and in speaking of Cooper's shrew, our author evidently confuses that diminutive insectivore with the rodents. The volume is completed by a very full and useful index, and Mr. Turner is to be congratulated, not only upon the appearance of his work, but upon the successful termination of his explorations and labors.

Another volume by the same author is promised soon by the Signal Office, also one from Mr. E. W. Nelson, upon the same region; and finally General Greely's own report upon the Lady Franklin Bay Expedition, which will be looked for with very general interest.

It is to be hoped that the government will appreciate more and more such works and the reports thereon, and be induced to aid and encourage them as much as possible.

R. W. SHUFELDT.

Fort Wingate, N.Mex., July 22.

The Use of the Microscope as a Practical Test for Oleomargarine.

THE act passed by Congress entitled "An Act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine," approved August 2, 1886, commonly known as the 'oleomargarine law,' makes it the duty of the Commissioner of Internal Revenue to prescribe all needful regulations for carrying it into effect.

From the 1st of November, 1886, when the law first went into effect, to October, 1887, one hundred and thirty-one samples of substance supposed to be oleomargarine were submitted for the decision of the commissioner under sections 14 and 15 of this act, twenty-one of which proved on analysis to be oleomargarine, and one hundred and ten were found to be butter. Most of these latter were old and rancid. The very prevalent idea that rancidity is the most characteristic property of oleomargarine may account for the

large number of samples of rancid butter seized by the Internal Revenue officers. It seems hardly necessary to say that oleomargarine, owing to its containing a comparatively small amount of the volatile and easily decomposable glycerides, keeps in a 'sweet' condition for a much longer time than butter.

Any instrument that can be placed in the hands of those officers who are charged with the enforcement of the law, whereby they can readily distinguish between the natural and artificial product, would be very desirable.

The difference between fresh, genuine, unmelted butter and oleomargarine, which is always made in whole or in part of melted fats, can be readily and clearly detected by a microscope with the aid of polarized light, and with or without the use of a selenite plate to color the field of vision. It is true that genuine butters are sometimes accidentally melted, so that while the presence of melted fats is not a sure indication that the article is oleomargarine, their entire absence in the article found in the markets removed from the place of manufacture is a very strong indication that it is butter.

The use of the microscope for the purpose of observing the presence of melted fats in a fresh sample was first brought to the attention of chemists in 1873, in an article on butter, by Dr. I. Campbell Brown, from the 'Liverpool and Manchester Medical and Surgical Reports, 1873,' republished in the *Chemical News*, vol. 28, p. 1, July 4, 1873. Such inspection can be readily performed without previous preparation of the sample, and a large number of samples can be examined in a short time.

The expense of large instruments with the necessary attachments, as usually made for laboratories, rendered them unsuitable for use by local officers in the markets or stores in which butter and oleomargarine are sold. In December last I came across a convenient and cheap form of microscope, to which under my directions the proper polarizing attachments were added. Owing to delays of the manufacturers a sufficient number of the instruments was not secured till last April. These were placed in the hands of the collectors of internal revenue with full directions for use, etc.

The instrument consists, first, of a large bell-shaped base, having at its mouth a silvered mirror acted upon by a spring, and at its apex a tube fitted with a tightening ring; second, a draw-tube, working in the tube which forms the upper part of the base, containing a good Huyghenian eye-piece, and at its other end a ring to which the analyzer and objective, one-half inch, may be screwed; and, third, the polarizer, fitted with a small condensing lens, and provided with a milled head whereby it can be rotated, is attached, by suitable means, to the mouth of the base. For convenience in focusing, marks are placed on the draw-tube, giving the approximate focus for ordinary thickness of objects.

The instrument is carried in a small wooden box eight inches long by five inches wide and deep, containing a number of glass slides and covers, and having pasted on the inside of the box-cover photo-lithographs of a fresh sample of oleomargarine and of butterine viewed under polarized light, — 'butterine' being the trade name for the product consisting principally of lard with from ten to twenty-five per cent of creamery butter. The box is fitted with a handle.

A small portion of the fresh sample taken from the inside of the mass — to avoid crystals of salt and accidental melting of the outside of the sample — with the point of a penknife is placed on the middle of a glass slide and covered. The gentle pressure of the blunt end of a pencil spreads the sample out to make it sufficiently translucent. On looking through the instrument, at the prepared slide, held towards the direct light from a window, or a gas or lamp flame placed within a short distance, a sharp focus is quickly obtained, and on rotating the polarizer until the field is dark the presence of melted fats will be readily recognized by the bright white particles with which the whole field is illuminated. But where nothing is seen except the characteristic globules, the granular masses of curd, and the cubical crystals of salt, even when the polarizer is turned so that the field passes from the darkest to the lightest, the sample can at once be passed as genuine butter however rancid to the taste or smell it may be.

Boiled or 'ladle-packed' butter, made from old rancid butters, melted and churned with a small quantity of milk, and very rancid butter may sometimes be mistaken for oleomargarine, but by hav-

ing a slide of oleomargarine or butterine ready for comparison, the difference is easily perceived. The hard fats, palmitin and stearin, exist in a state of solution in the globules of a fresh sample of butter and in the fats of living animals. Upon being melted and cooled these hard fats separate out in the form of acicular crystals which polarize light, owing to their being double-refracting bodies.

In the latter part of April I was instructed to proceed to Philadelphia and New York and assist the local revenue officers in the examination of samples of butter collected in those cities. This investigation was afterwards extended to other cities in May and June, and samples of all grades of butter handled by retail butter dealers were collected and examined, the object being to ascertain to what extent and by whom oleomargarine was sold without complying with the law.

The principal cities and towns in New York and Pennsylvania, and the cities of Baltimore, Washington, Hartford, and New Haven, were visited, and the samples examined by the revenue agents connected with those districts.

The method of procedure was generally as follows. On a certain day all the division deputy collectors in the city and vicinity in which the examination was to be made were detailed with instructions to visit the stores of all, if possible, retail dealers in butter, except those who had paid the special tax as dealers in oleomargarine, and to obtain a sample of each grade of butter dealt in. For this purpose each deputy was furnished with a wooden box, containing a gross of half-ounce specimen tubes, with the necessary number of gummed labels and blank forms for noting address, etc., of the dealers visited. At the end of the day the samples collected were brought to the office and placed in an ice-chest. From two to three days were devoted to this canvass. The samples were examined as soon as possible after they were received, and any specimen found showing the presence of melted fats was at once thoroughly investigated and the dealer's store visited and the goods detained, etc. Most of these cases proved on investigation that the so-called butter had been bought from a regular oleomargarine dealer or received direct from the factory.

The following table shows the number of samples of butters that have been examined in the different cities named and the number found to be oleomargarine.

Locality.	No. of Samples.	Representing Stock of Dealers.	Oleomargarine.
Philadelphia, Penn.....	656	288	2
Brooklyn, N.Y.	632	346	5
New York, N.Y.	2998	1862	3
Jersey City, N.J.....	234	145	2
Newark, N.J.	280	175	1
Paterson, N.J.	122	64	7
Hoboken, N.J.....	84	49	0
Elizabeth, N.J.....	103	77	1
Boston, Mass.	1181	595	2
Lowell, Mass.....	59	19	4
Salem, Mass.....	57	28	0
Cincinnati, O.	651	424	6
Indianapolis, Ind.....	233	152	2
Chicago, Ill.	719	346	2
Milwaukee, Wis.	574	362	0
Baltimore, Md.	228	141	1
Washington, D.C.....	149	89	0
Four towns, Conn.....	822	478	1
Eighteen towns, Penn.....	599	456	19
Eleven towns, N.Y.....	596	426	0

EDGAR RICHARDS.

Washington, D.C., July 26.